

TREASURY DEPARTMENT

Public Health and Marine-Hospital Service of the United States

PUBLIC HEALTH BULLETIN No. 33

STUDIES UPON LEPROSY

VII. A STATISTICAL STUDY OF AN ENDEMIC FOCUS
OF LEPROSY

BY

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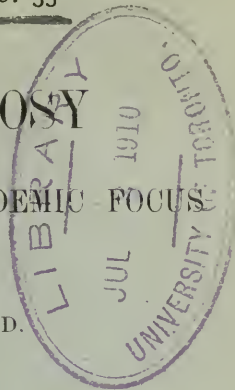
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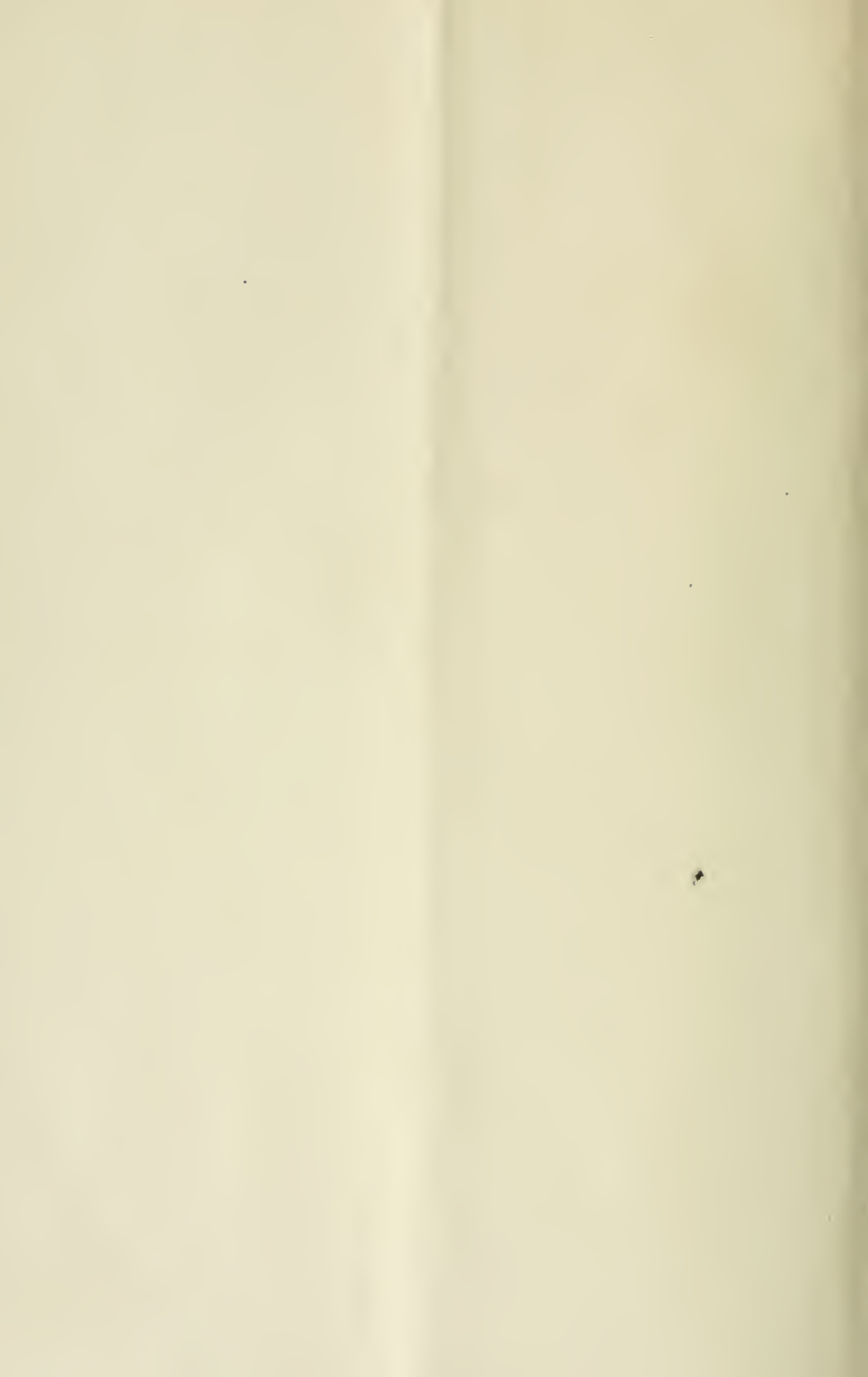


WASHINGTON

GOVERNMENT PRINTING OFFICE

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A STATISTICAL STUDY OF AN ENDEMIC FOCUS OF LEPROSY.

By WALTER R. BRINCKERHOFF, S. B., M. D., *Assistant Director*, and A. C. REINECKE, *Technical Assistant*,

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INTRODUCTION.

Much has been written about the endemic focus of leprosy which has existed in the Hawaiian Islands for about half a century, but until the completion of the thoroughgoing analysis of the official records of the Hawaiian Territorial Board of Health which appears in the following pages, the rich epidemiological data upon leprosy yielded by this focus of the disease have never received the careful treatment which they deserve.

The computations of this report have been checked and rechecked and are, we believe, as accurate as is possible within the limitation prescribed by the basic data and the percentage of error inherent in such work.

TABLE I.—*Number of new cases of leprosy, apprehended by years and by five-year periods in the Territory of Hawaii.*

Year.	New cases.		Year.	New cases.	
	By years.	By five-year periods.		By years.	By five-year periods.
1881.....	195	777	1896.....	147	513
1882.....	70		1897.....	126	
1883.....	301		1898.....	80	
1884.....	108		1899.....	58	
1885.....	42		1900.....	102	
1886.....	103	1,310	1901.....	86	459
1887.....	220		1902.....	74	
1888.....	558		1903.....	115	
1889.....	306		1904.....	86	
1890.....	184		1905.....	98	
1891.....	142	704	1906.....	56	177
1892.....	109		1907.....	95	
1893.....	210		1908.....	26	
1894.....	137				
1895.....	106		Total.....	3,940	3,940

The most striking thing about this table is the surprising variation in the number of lepers segregated each year. It is not possible to understand the variation in the annual number of lepers segregated without some knowledge of the political history of the Territory.

From the beginning of our table until 1893 the form of government was monarchical, the native ruler being more or less under the influence of foreign advisers. The sudden increase in lepers apprehended in 1887, 1888, and 1889 finds its explanation in the fact that a new constitution was forced upon the native ruler and a reorganization

of the personnel of the board of health was insisted upon by the foreigners then in power. In 1893 a revolution resulted in the formation of a republic, which was followed by a provisional government, which in turn gave way to American rule when the islands were annexed by the United States in 1898. It will be noted that the revolution in 1893 was followed by an increase in the number of lepers apprehended.

Considering the number of lepers apprehended by five-year periods, we see that the period from 1886 to 1890 was the time of greatest activity. It is probable that some of the decrease in the following decade is due to the good work done during that period. Since 1900 it is probable that the decrease is apparent rather than real, and the dying out of the native Hawaiian race, which furnished the bulk of the lepers, is not the real cause of the decrease of the disease.

TABLE 2.—*Number of new cases of leprosy apprehended, by years and by five-year periods, in each island of the Territory of Hawaii.*

Year.	Oa-hu.	Hawaii.	Maui.	Ka-na-i.	Molo-kai.	Year.	Oa-hu.	Hawaii.	Maui.	Ka-na-i.	Molo-kai.
1881.....	28	34	94	12	26	1896.....	39	69	18	12	9
1882.....	24	18	9	6	13	1897.....	38	33	21	19	15
1883.....	83	82	85	33	18	1898.....	25	19	24	7	5
1884.....	42	28	24	3	11	1899.....	27	7	14	10	0
1885.....	9	24	24	15	31	1900.....	29	53	16	4	0
	186	186	236	69	99		158	181	93	52	29
1886.....	10	6	8	1	17	1901.....	34	20	21	8	3
1887.....	56	36	90	14	24	1902.....	43	7	12	11	1
1888.....	214	171	108	58	7	1903.....	59	38	5	11	2
1889.....	118	103	71	5	9	1904.....	38	11	33	2	2
1890.....	83	38	36	19	8	1905.....	57	24	12	4	1
	481	354	313	97	65		231	100	83	36	9
1891.....	50	42	27	12	11	1906.....	25	18	7	6	0
1892.....	25	37	37	9	1	1907.....	35	20	20	7	13
1893.....	86	47	25	44	8	1908.....	11	9	0	6	0
1894.....	53	28	13	29	11		71	47	27	19	13
1895.....	50	9	32	12	3						
	264	163	134	106	37	Grand total.	1,391	1,031	886	379	252

In one case no island was given.

NOTE.—The small island of Lanai is included with Maui. The small island of Niihau is included with Kauai.

The Territory of Hawaii, for our purposes, consists of five islands, which constitute the political subdivisions of the Territory. These islands are Oahu (area 600 square miles, population 58,504); Hawaii (area 4,015 square miles, population 46,843); Maui (area 932 square miles, population 25,416); Kauai (area 641 square miles, population 20,734); Molokai (area 261 square miles, population 2,504).

This table shows that the island of Oahu yields the majority of the cases of leprosy in the Territory; Hawaii, Maui, Kauai, and Molokai following in the order named. If we compare the number of lepers from each island with the *gross* population of the respective islands, we see that they are in direct proportion. As, however, the majority of the lepers come from the native race, it is necessary to compare the

native population by islands with the number of native lepers from each island. When this is done we find that the cases of leprosy are in direct proportion to the *native* population.

Taking the mean number of lepers per year for the period 1896-1905 for each island and the native population of each island for the census year 1900, which would be in the middle of the decade from which we compute our mean lepers per year, we find that on the island of Oahu the morbidity of leprosy, among the native race, was 21.2 per 10,000; on the island of Hawaii, 25.1 per 10,000; on the island of Maui, 21.7 per 10,000; on the island of Kauai, 23.8 per 10,000; on the island of Molokai, 18.6 per 10,000.

The analysis of the above figures shows that, arranging the islands in order of the native population, they are Oahu, Hawaii, Maui, Kauai, and Molokai, while, if we arrange them in the order of the morbidity of leprosy among the native population, the order is Hawaii, Kauai, Maui, Oahu, and Molokai. The amount of leprosy in the Territory of Hawaii is known to be large, but when reduced to the conventional form of expression a morbidity of 25.1 per 10,000 of the native population on the island of Hawaii is certainly extraordinary.

The island of Oahu yields the greatest number of lepers per year, but the disease seems to be more prevalent among the native race on the islands of Hawaii, Kauai, and Maui. As a corollary to this we find that the occurrence of leprosy in the non-Hawaiian portion of the population is greatest on the island of Oahu, which contains approximately half of the Caucasian population of the Territory. We see from this that leprosy in the Territory of Hawaii is not confined to the remote districts.

TABLE 3.—*Number of new cases of leprosy apprehended by years and by five-year periods. from districts of the island of Oahu.*

Year.	Kona.	Koolaupoko.	Koolauloa.	Waialua.	Waianae.	Ewa.	Year.	Kona.	Koolaupoko.	Koolauloa.	Waialua.	Waianae.	Ewa.
1881.....	25	2	0	1	0	0	1896.....	31	3	1	1	0	3
1882.....	20	0	1	0	2	1	1897.....	30	6	1	0	0	1
1883.....	43	18	7	7	0	8	1898.....	19	3	1	1	0	1
1884.....	35	3	1	2	1	0	1899.....	21	2	0	0	3	0
1885.....	3	2	0	2	0	2	1900.....	23	1	1	2	0	2
	126	25	9	12	3	11		124	15	4	4	3	7
1886.....	7	0	0	0	2	1	1901.....	30	0	1	1	0	3
1887.....	37	0	2	9	4	4	1902.....	39	2	0	1	1	0
1888.....	155	12	8	11	9	17	1903.....	42	5	8	2	2	0
1889.....	87	3	11	13	3	1	1904.....	33	0	0	3	0	1
1890.....	74	2	3	1	2	1	1905.....	50	1	3	2	0	1
	360	17	24	34	20	24		194	8	12	9	3	5
1891.....	39	4	0	4	2	0	1906.....	21	2	1	0	0	1
1892.....	21	0	0	0	0	4	1907.....	25	0	7	3	0	0
1893.....	71	7	1	4	1	0	1908.....	7	1	1	2	0	0
1894.....	42	1	3	5	0	2		53	3	9	5	0	1
1895.....	30	3	4	2	2	8		1,060	83	66	79	34	62
	203	15	8	15	5	14	Grand total.....						

There were seven cases reported with no district given.

The island of Oahu, on which is situated the city of Honolulu, the capital of the Territory, as we have seen (Table 2), yields more lepers per year than any other island of the group. On examining Table 3 it will be found that the great majority of the cases of leprosy occurring on the island of Oahu come from the Kona district, which coincides with the boundaries of the city of Honolulu, under county government. During the last twenty-eight years the average annual yield of lepers from the city of Honolulu was 37.8.

Considering the occurrence of leprosy during the decade 1896-1905 in comparison with the population by the races, we get the following results:

Morbidity of leprosy per 10,000 of the total population of the city of Honolulu was 8.0.

Morbidity of leprosy per 10,000 of the native population of the city of Honolulu was 22.4.

Morbidity of leprosy per 10,000 of the non-Hawaiian population of the city of Honolulu was 2.1.

We see from this that even if we disregard the rest of the Territory, the occurrence and racial distribution of leprosy in the capital city presents a condition worthy of the most serious consideration and thoroughgoing efforts for the control of the disease.

TABLE 4.—*Number of new cases of leprosy apprehended by years and five-year periods from districts of the island of Hawaii.*

Year.	Hilo.	Kau.	Puna.	Kona.	Kohala.	Hamakua.	Year.	Hilo.	Kau.	Puna.	Kona.	Kohala.	Hamakua.
1881.....	6	3	0	10	14	0	1896.....	15	3	6	16	8	9
1882.....	5	3	1	3	6	0	1897.....	1	2	1	22	3	4
1883.....	27	9	3	13	20	9	1898.....	0	0	0	13	5	
1884.....	10	2	2	4	2	8	1899.....	3	0	0	1	1	2
1885.....	3	2	3	7	7	2	1900.....	8	4	1	21	11	2
	51	19	9	37	49	19		28	13	8	60	36	28
1886.....	1	0	0	1	1	3	1901.....	5	3	2	9	0	1
1887.....	10	9	2	0	8	7	1902.....	0	4	0	0	0	1
1888.....	43	18	5	37	47	18	1903.....	5	4	1	9	12	7
1889.....	17	7	1	55	20	3	1904.....	1	1	1	7	1	0
1890.....	8	2	0	8	10	10	1905.....	11	0	1	0	8	4
	79	36	8	101	86	41		24	8	9	25	21	13
1891.....	9	1	10	9	2	9	1906.....	9	4	0	2	2	0
1892.....	7	9	2	5	13	1	1907.....	8	2	2	5	2	1
1893.....	8	4	6	12	12	4	1908.....	4	0	1	0	3	1
1894.....	5	4	1	7	9	2		21	6	3	7	7	2
1895.....	0	0	0	3	6	0							
	29	18	19	36	42	16	Grand total.....	232	100	56	266	241	119

There were seventeen cases reported with no districts given.

As we have seen from Table 2, the island of Hawaii has more lepers per thousand of the native population than any other island of the group. If we compute the morbidity of leprosy per 10,000 of the native population for each district of the island, we find Hilo, 22.0; Kau, 21.6; Puna, 18.4; Kona, 22.7; Kohala, 29.8; Hamakua, 35. It is evident from these figures that the amount of leprosy in the native race on the island of Hawaii is excessive. A morbidity for a

chronic infectious disease of 35 per 10,000 of the population certainly requires prompt and vigorous measures for the control of the disease.

TABLE 5.—*Number of new cases of leprosy apprehended by years and by five-year periods from districts of the island of Maui.*

Year.	Kona.	Wailuku.	Kahikini.	Hana.	Koolau.	Hamakua.	Makawao.	Lamai.	Year.	Kona.	Wailuku.	Kahikini.	Hana.	Koolau.	Hamakua.	Makawao.	Lamai.
1881.....	10	46	5	11	0	18	2	0	1896.....	2	8	3	3	0	0	1	1
1882.....	0	2	0	3	0	3	1	0	1897.....	3	4	3	8	3	0	0	0
1883.....	12	31	10	12	5	6	8	0	1898.....	2	15	1	1	1	1	3	0
1884.....	6	9	1	3	2	1	2	0	1899.....	1	10	1	0	0	0	1	1
1885.....	5	8	1	5	0	2	2	0	1900.....	1	4	3	4	4	0	0	0
	33	96	17	34	7	30	15	0		9	41	11	16	8	1	5	2
1886.....	0	3	2	2	0	1	0	0	1901.....	5	5	2	9	0	0	0	0
1887.....	19	38	6	16	5	3	3	0	1902.....	4	4	0	4	0	0	0	0
1888.....	16	49	10	17	0	1	15	0	1903.....	1	1	0	2	0	0	1	0
1889.....	13	30	5	12	3	2	6	0	1904.....	9	8	0	11	0	0	5	0
1890.....	2	23	0	6	0	5	5	0	1905.....	0	12	0	0	0	0	0	0
	50	143	23	53	8	7	29	0		19	30	2	26	0	0	6	0
1891.....	2	10	6	7	0	0	1	0	1906.....	3	3	0	0	0	0	0	1
1892.....	7	9	3	1	1	1	2	9	1907.....	1	7	1	5	2	0	4	0
1893.....	9	6	2	0	3	2	3	0	1908.....	0	0	0	0	0	0	0	0
1894.....	0	8	0	2	0	2	0	0		4	10	1	5	2	0	4	1
1895.....	2	18	0	5	2	1	4	0	Grand total..	135	371	65	149	31	44	69	12
	20	51	11	15	6	6	10	9									

In eleven cases no districts were mentioned.

A computation of the morbidity of leprosy in the different districts on the island of Maui can only be made in the case of Wailuku district, owing to the fact that the United States census districts do not coincide with the geographical divisions used by the natives in locating their place of residence.

The morbidity of leprosy in the Wailuku district was 26.3.

TABLE 6.—*Number of new cases of leprosy apprehended by years and by five-year periods from districts of the island of Kauai.*

Year.	Kona.	Puna.	Koolau.	Haleleia.	Napali.	Niihau.	Year.	Kona.	Puna.	Koolau.	Haleleia.	Napali.	Niihau.
1881.....	9	0	0	2	0	0	1896.....	3	12	0	1	0	0
1882.....	3	1	0	2	0	0	1897.....	6	1	1	4	1	0
1883.....	22	8	1	2	0	0	1898.....	0	3	0	4	0	0
1884.....	1	0	0	2	0	0	1899.....	0	6	0	4	0	0
1885.....	6	6	1	2	0	0	1900.....	0	1	0	3	0	0
	41	15	2	10	0	0		9	19	1	19	1	0
1886.....	1	0	0	0	0	0	1901.....	4	2	0	1	0	1
1887.....	4	4	2	4	0	0	1902.....	3	3	2	2	0	1
1888.....	39	9	4	2	4	0	1903.....	0	8	0	3	0	0
1889.....	2	2	0	1	0	0	1904.....	0	2	0	0	0	0
1890.....	8	8	0	3	0	0	1905.....	3	1	0	0	0	0
	54	23	6	10	4	0		10	16	2	6	0	2
1891.....	3	8	0	1	0	0	1906.....	5	1	0	0	0	0
1892.....	3	2	0	0	0	0	1907.....	1	5	0	1	0	0
1893.....	1	0	0	11	23	9	1908.....	3	1	0	1	0	1
1894.....	10	7	0	11	0	0		9	7	0	2	0	1
1895.....	8	3	0	1	0	0	Grand total...	150	100	11	71	28	12
	27	20	0	24	23	9							

In seven cases no districts were mentioned.

The native districts and the geographical divisions used by the United States census do not correspond on this island, so it is impossible to give the morbidity of the disease by districts. On examining Table 6 it will be seen that the Kona district yields the largest number of cases of leprosy per year.

It will be noted that in the year 1893 twenty-three cases of leprosy came from the Napali district. The region in question is one of the most inaccessible parts of the Territory, and a number of lepers had congregated there under the leadership of a leper outlaw. It was necessary to use military force to bring about the arrest of these cases. This episode was a part of the policy of enforcing the segregation coincident with the revolution which ushered in the republican form of government in 1893.

TABLE 7.—*Number of new cases of leprosy apprehended by years and by five-year periods from the island of Molokai.*

Year.	New cases.	Year.	New cases.	Year.	New cases.
1881.....	26	1891.....	11	1901.....	3
1882.....	13	1892.....	1	1902.....	1
1883.....	18	1893.....	8	1903.....	2
1884.....	11	1894.....	14	1904.....	2
1885.....	31	1895.....	3	1905.....	1
	99		37		9
1886.....	17	1896.....	9	1906.....	0
1887.....	24	1897.....	15	1907.....	13
1888.....	7	1898.....	5	1908.....	0
1889.....	9	1899.....	0		13
1890.....	8	1900.....	0		
	65		29	Grand total.....	252

Some of the cases of leprosy originating on the island of Molokai were boys born of leprosy parents, who remained at the leper settlement until they contracted the disease; while some were clean native helpers at the settlement, who had become superannuated and were put on the leper list (with their consent) in order that they might receive rations. After deducting these two classes of cases, the number of bona fide cases of leprosy originating on the island of Molokai, outside of the leper settlement, is too small for statistical treatment.

TABLE 8.—*Number of new cases of leprosy each year per 10,000 of the population by races.*

Year.	Hawaiian and part Hawaiian.	Caucasians.	Other nationalities.	Year.	Hawaiian and part Hawaiian.	Caucasians.	Other nationalities.
1881.....	41.1	2.7	2.5	1895.....	25.5	0.4	0.8
1892.....	15.5	.0	1.3	1896.....	36.4	1.1	.5
1893.....	66.7	.0	.6	1897.....	28.9	1.8	1.5
1894.....	24.2	.6	2.6	1898.....	18.4	1.8	.8
1895.....	22.3	1.1	1.4	1899.....	13.9	.7	.4
1896.....	8.4	1.5	1.3	1900.....	23.4	2.1	.8
1897.....	51.4	.5	1.2	1901.....	20.3	.3	1.1
1898.....	129.1	3.5	3.6	1902.....	16.7	2.0	.6
1899.....	72.4	1.0	2.2	1903.....	25.4	2.3	1.3
1900.....	41.5	2.4	3.2	1904.....	18.9	2.9	.8
1901.....	34.8	.9	.3	1905.....	22.5	1.3	1.1
1902.....	26.0	1.3	.6	1906.....	11.7	1.2	.8
1903.....	50.7	1.2	1.2	1907.....	21.7	2.7	.7
1904.....	37.0	1.6	1.3	1908.....	5.2	1.2	.3

We see by examining column 1 of Table 8 that the fluctuation in the relative number of new cases of leprosy per 10,000 of the native population coincides fairly well with the variations in the actual number of cases per year, as shown in Table 1, and the explanation is to be sought partly in the political history of the Territory. The policy in 1888 has undoubtedly influenced the incidence of the disease in the Territory up to 1900. Since that time, however, it is evident that the disease is gaining headway.

With regard to the Caucasian lepers (column 2), it is evident that the disease underwent a slight diminution in this race, following the policy of 1888, but that since 1900 the disease is increasing, both relatively and absolutely, in this class of the population. The occurrence of the disease in other nationalities in the Territory is a repetition of that amongst the Caucasians.

TABLE 9.—*Age of lepers at apprehension.*

Year.	1 to 5.	6 to 10.	11 to 15.	16 to 20.	21 to 25.	26 to 30.	31 to 35.	36 to 40.	41 to 45.	46 to 50.	51 to 55.	56 to 60.	61 to 65.	66 to 70.	71 to 75.	76 to 80.	81 to 85.	86 to 90.	91 to 95.	96 to 100.
1881.....	0	8	26	29	16	21	15	23	9	16	2	8	4	3	5	1	2	0	0	0
1882.....	2	7	5	13	4	13	1	4	3	4	1	4	1	1	2	3	0	0	0	0
1883.....	0	9	27	40	23	42	25	25	25	27	17	15	10	6	1	5	0	4	0	0
1884.....	1	5	16	12	7	10	12	18	2	10	4	6	3	1	0	0	0	1	0	0
1885.....	1	6	2	19	7	15	5	19	6	12	1	4	0	4	0	0	0	0	0	0
1886.....	0	0	3	5	2	3	1	5	5	5	0	4	1	0	0	0	0	0	0	0
1887.....	1	14	35	36	22	19	18	22	17	7	10	10	2	4	0	2	0	0	0	0
1888.....	6	29	104	91	59	55	31	49	25	42	17	19	10	8	2	3	2	2	0	0
1889.....	1	25	56	50	41	25	18	19	11	15	11	14	5	4	1	4	1	3	0	0
1890.....	0	15	29	30	12	23	13	22	5	14	5	11	0	3	0	1	0	0	0	0
1891.....	1	14	22	26	15	11	11	9	5	12	1	8	2	5	0	0	0	0	0	0
1892.....	1	10	22	25	10	10	12	5	3	1	4	3	0	3	0	1	0	0	0	0
1893.....	0	14	37	34	28	27	18	8	9	12	4	7	4	4	4	0	0	0	0	0
1894.....	0	10	33	33	12	9	5	10	6	6	6	4	1	0	0	1	0	0	0	0
1895.....	0	13	18	27	9	8	5	6	5	3	5	5	0	2	0	0	0	0	0	0
1896.....	1	11	17	35	11	11	10	13	7	8	5	3	3	3	2	4	0	0	0	0
1897.....	1	9	34	11	12	14	14	8	6	4	3	2	1	0	2	0	0	0	0	1
1898.....	0	5	16	15	4	6	4	8	4	1	7	6	0	0	1	3	0	0	0	0
1899.....	0	3	11	14	9	6	4	7	3	0	0	0	1	0	0	0	0	0	0	0
1900.....	1	4	13	35	11	8	3	6	4	6	2	4	2	2	0	0	0	0	0	0
1901.....	0	4	18	19	11	9	3	9	4	2	2	1	1	3	0	0	0	0	0	0
1902.....	0	7	11	15	7	8	5	6	1	5	1	3	1	3	1	0	0	0	0	0
1903.....	0	5	19	25	19	15	6	4	3	7	6	1	2	3	0	0	0	0	0	0
1904.....	2	8	16	10	12	8	2	9	2	5	4	3	2	1	2	0	0	0	0	0
1905.....	0	5	14	13	10	9	11	12	4	7	8	3	1	1	0	0	0	0	0	0
1906.....	0	1	11	9	10	4	6	2	1	3	1	2	2	2	1	0	0	0	0	0
1907.....	2	5	9	15	15	14	8	8	5	1	6	5	1	1	0	0	0	0	0	0
1908.....	0	2	5	4	5	2	2	0	3	1	2	0	0	0	0	0	0	0	0	0
Total.....	20	248	629	693	406	405	268	336	183	236	135	155	60	67	24	28	5	10	0	1

There were thirty-one cases recorded with no age given.

The analysis of Table 9 shows that there are more cases of leprosy between the ages of 10 and 31 than all the other periods together. This indicates clearly that the disease is one which affects particularly the adolescent and young adult elements of the population. It is, therefore, a factor in the economic problem in the Territory, as the majority of its victims are of the age of maximum working efficiency.

If we divide the twenty-eight years under consideration into two periods of 14 years each and compute the percentage of lepers under 30 years of age and over 30 years of age for each of these 14-year periods, we find that during the latter period (1895–1908) there has been a distinct, though slight, relative increase in the number of lepers under 30 years of age, as against the first period. This accentuates the conclusion drawn from the total figures, to wit: That the disease is pre-eminently one of the public-school and early adult-life periods.

TABLE 10.—*Sex of lepers apprehended, by years.*

Year.	Males.	Females.	Year.	Males.	Females.
1881.....	131	63	1896.....	100	47
1882.....	52	18	1897.....	82	44
1883.....	184	116	1898.....	51	29
1884.....	71	37	1899.....	40	18
1885.....	74	29	1900.....	77	25
1886.....	33	9	1901.....	60	26
1887.....	137	83	1902.....	53	21
1888.....	348	210	1903.....	67	48
1889.....	178	218	1904.....	54	32
1890.....	109	74	1905.....	66	32
1891.....	81	61	1906.....	34	22
1892.....	60	49	1907.....	64	31
1893.....	128	82	1908.....	19	7
1894.....	85	51			
1895.....	64	42	Total.....	2,502	1,434

An examination of Table 10 shows that approximately two-thirds of the cases of leprosy occur in males. Such a sex distribution of the disease has been observed in other countries, but so far as we are aware no adequate explanation of the phenomenon has been found.

The predominance of males among the lepers, unless due to a sex susceptibility, would indicate that the disease is acquired without rather than within the home circle. This deduction is not in accord with the current theories as to the mode of transmission of leprosy.

The sex distribution of the disease again emphasizes its economic importance, as it attacks preeminently wage-earners.

TABLE 11.—*Number of new cases of leprosy a year (1901–1905) per 10,000 of the living Hawaiian and part Hawaiian population at different age periods.*

Age.	Number per 10,000.	Age.	Number per 10,000.	Age.	Number per 10,000.
0 to 10.....	6.6	31 to 40.....	27.2	61 to 70.....	20.0
11 to 20.....	41.8	41 to 50.....	21.2		
21 to 30.....	32.4	51 to 60.....	32.0		

Table No. 9 dealt with the absolute number of lepers of different age periods. In Table 11 is shown the ratio between the number of Hawaiian and part Hawaiian lepers of different age periods, and the number of Hawaiians and part Hawaiians of the same age period. It is evident from this table that the absolute as well as

the relative greatest incidence of the disease falls in the second decade (11 to 20 years of age). It has been shown that the average duration of the disease before apprehension in the Territory has been four years; we therefore feel justified in concluding that a very large proportion of all cases of leprosy receive their infection during the school-age period.

TABLE 12.—*Estimated number of Hawaiian lepers at large at the close of 1907.*

Average annual yield of lepers.....	72
Average duration of disease, years.....	4
Estimated Hawaiian population, 1906.....	35,000
Gross estimated lepers at large.....	288
Death rate of lepers (1903-1905), per cent.....	11
Correction: Lepers dying at large.....	71
Net lepers at large, end of 1907.....	217
Estimated number of Hawaiians per leper at large.....	165
Estimated leper at large per 1,000 of native population.....	6

This computation was made to determine the minimum number of Hawaiian and part-Hawaiian inhabitants of the Territory that should be examined to yield a case of leprosy not yet officially recognized. The computed number of lepers at large, therefore, does not include cases free in the community. It simply means that if the patients have the disease on an average of four years before segregation is effected, unless there be a sudden change in the death rate at large or in the spread of the disease in the community, there will always be what we might call a residuum of over two hundred undetected lepers free in the community. If segregation is not being rigidly enforced or has not been rigidly enforced during the period from which we draw our statistics for this computation, it is obvious that the total lepers at large must be very much greater.

TABLE 13.—*Lepers of school age, 1899 to 1908, inclusive.*

Territory of Hawaii:

Total lepers apprehended in Territory for this period.....	796
Lepers of school age, same period (6 to 15 years of age).....	171
Percentage of lepers of school age.....	21½
Annual average yield of school age lepers.....	17.1

City of Honolulu:

Total lepers apprehended in Kona district, island of Oahu.....	291
Lepers of school age, same period (6 to 15 years of age), Kona district, island of Oahu.....	69
Percentage of lepers of school age.....	23
Annual average yield of school age lepers.....	6.9

In several previous tables we have called attention to the close relation which subsists between age and the occurrence of leprosy. The predominance of the disease in the early decades of life immediately suggests that if the public school system is conducted without

thoroughgoing inspection, it may be functioning as a vehicle for the dissemination of leprosy as well as education.

A scrutiny of this table shows that one-fifth of all lepers apprehended in the Territory each year are of school age, and that in the city of Honolulu almost one-quarter of the lepers each year are of the same age period. In other words, the Territory yields over seventeen "school age lepers" and the city of Honolulu over six "school age lepers" each year.

In considering these figures it must be borne in mind that inasmuch as all lepers segregated have had the disease for some years before apprehension, a certain number of lepers which do not figure in the above computation must have received their infection when they were or should have been in school.

TABLE 14.—*General leprosy statistics, Hawaii.*

Year.	New cases.	Total lepers in segregation.	Died.	Mortality.	Year.	New cases.	Total lepers in segregation.	Died.	Mortality.
				<i>Per cent.</i>					<i>Per cent.</i>
1866.....	142	115	26	22.6	1888.....	558	1,035	188	18.1
1867.....	37	150	25	16.6	1889.....	306	1,187	150	12.6
1868.....	111	232	30	12.5	1890.....	184	1,213	158	13.0
1869.....	125	276	79	28.2	1891.....	142	1,142	213	18.6
1870.....	27	270	58	21.4	1892.....	109	1,095	147	13.4
1871.....	181	399	51	12.7	1893.....	210	1,153	149	12.9
1872.....	105	437	64	14.6	1894.....	137	1,124	154	13.7
1873.....	477	757	156	20.6	1895.....	106	1,087	130	11.9
1874.....	90	674	161	23.8	1896.....	147	1,115	115	10.3
1875.....	213	706	157	22.2	1897.....	126	1,099	139	12.7
1876.....	96	677	122	18.0	1898.....	80	1,059	113	10.6
1877.....	157	710	109	15.3	1899.....	58	1,014	104	10.2
1878.....	237	696	245	35.2	1900.....	102	983	137	13.9
1879.....	41	717	208	29.0	1901.....	86	900	177	19.6
1880.....	51	612	150	24.5	1902.....	74	874	106	12.2
1881.....	195	709	130	18.3	1903.....	115	872	101	11.5
1882.....	70	651	121	18.4	1904.....	86	855	107	11.3
1883.....	301	784	154	19.0	1905.....	98	853	95	11.1
1884.....	108	717	169	23.4	1906.....	56	833	84	10.0
1885.....	103	653	142	20.2	1907.....	95	808	88	10.8
1886.....	42	598	100	16.7	1908.....	26	796	25	3.1
1887.....	220	698	110	17.1					

The significance of the column showing new cases has been discussed previously (Table 1). From the column of total lepers we see that following the vigorous segregation of lepers in 1887, 1888, and 1889 for a period of ten years the Territory had the burden of supporting over 1,000 cases in their isolation colony. In spite of this increase in the population of the settlement, the death rate, as shown by the last column, was much lower than during the earlier years of segregation. In this connection the territorial authorities should be congratulated upon the steady decrease of the death rate in the leper settlement, showing the results of the excellent hygienic conditions with which the Territory surrounds sufferers from the disease.

TABLE 15.—*Actual number of white lepers segregated, by years and by seven-year periods.*

Year.	Oahu.	Hawaii.	Maul.	Kauai.	Molokai.	Total.	Year.	Oahu.	Hawaii.	Maul.	Kauai.	Molokai.	Total.
1881.....	3					3	1895.....	1					1
1882.....						0	1896.....	2	1				3
1883.....						0	1897.....		1				1
1884.....	1					1	1898.....	2		1			3
1885.....	1		1			2	1899.....		1		1		2
1886.....	2				1	3	1900.....	2		1	1		4
1887.....	1					1	1901.....	1					1
			1		1	10		11	5	2	2	3	23
1888.....	2		4			7	1902.....	5		1			6
1889.....	2					2	1903.....	7					7
1890.....	4					5	1904.....	7		2			9
1891.....	2			1		3	1905.....	4					4
1892.....	1				2	3	1906.....	3	1				4
1893.....	2		1			3	1907.....	4	2	1	1	1	9
1894.....	2	1			1	4	1908.....	2	1		1		4
	15	1	5	3	2	26		32	4	4	2	1	43
							Grand total.....	66	10	12	7	7	102

The total number of white lepers segregated in the Territory during the last twenty-eight years was 102, an average of 3.6 lepers per year. As these figures are based upon the official statistics of the board of health, no account is taken in them of the white lepers who have sufficient means to leave the Territory upon the discovery of the disease.

The island of Oahu produces over one-half of the white lepers. In twenty-eight years sixty-six such cases have come under the official notice of the board of health, an average of 2.35 per year.

The census of 1900 showed that 49 per cent of the white population of the Territory was on the island of Oahu, so it is to be expected that at least one-half of the white lepers would come from that island. If, however, we consider the distribution of the disease by islands for the seven years following the census year (1900) we see that the island of Oahu, with 49 per cent of the white population of the Territory, has produced 74 per cent of the white lepers apprehended during that time.

If we divide the period of twenty-eight years (1881-1908), covered by our statistics, into four equal periods of seven years each, we find that in the Territory at large leprosy is increasing among the whites, an increase which has become alarming during the last seven years: 1881-1887, ten cases; 1888-1894, twenty-six cases; 1895-1901, twenty-three cases; 1902-1908, *forty-three* cases. Grouping the cases of leprosy among the whites from the island of Oahu in the same way, we find that the disease has spread very rapidly among the whites on that island in the last seven years: 1881-1887, eight cases; 1888-1894, fifteen cases; 1895-1901, eleven cases; 1902-1908, *thirty-two* cases.

CONCLUSIONS.

1. Leprosy in Hawaii is quite evenly distributed throughout the Territory. The morbidity of the disease varies somewhat on different islands, and is most prevalent among the Hawaiian and part Hawaiian portion of the population, but is everywhere so high that the results of comparison are of trivial importance in the face of such a great menace to public health as an average of well over twenty per 10,000 of the native population. (Table 2.)

2. Leprosy in Hawaii is not confined to the remote districts, the capital of the Territory being one of the principal sources of cases. (Table 3.)

3. The prevalence of leprosy in certain districts on the island of Hawaii is notable. (Table 4.)

4. Leprosy in the Territory is most prevalent in the adolescent and early adult age periods and therefore bears a distinct relation to the public education, as the bulk of the lepers are either of school age or have received their infection during that period. (Table 9.)

5. The predominance of males (Table 10) and young adults (Table 9) among lepers in the Territory introduces the disease as an element in the local economic problem. Segregation withdraws many wage-earners from the community in their early prime.

6. The close relationship which exists between the occurrence of leprosy and the school age period indicates that a campaign for the control of the disease can not be successful, which does not contemplate careful supervision of the conditions under which this class of the population congregate, i. e., the school room. (Table 11.)

7. It seems evident (Table 13) that an elaborate public school system without thoroughgoing medical inspection may result in the development of an institution for the propagation of leprosy as well as the dissemination of knowledge. (Table 12.)

8. The steady improvement in the hygienic conditions in the Leper Settlement, as shown by the decrease in the death rate, testifies strongly to the practical humanitarianism of the Territory of Hawaii in dealing with the sufferers from the disease. (Table 14.)

9. There has been a notable increase in the number of cases of leprosy among the white inhabitants of the Territory of Hawaii in the last seven years, particularly on the island of Oahu.

A PALLIATIVE TREATMENT FOR LEPROUS RHINITIS.

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Complaints of epistaxis and nasal obstruction from two-thirds of the lepers under treatment brought home to us the desirability of seeking a palliative treatment for leprous rhinitis.

A careful search of the literature at our command revealed one reference to the treatment of leprous rhinitis.^a Hollmann found the use of a spray, composed of eucalyptol and alboline, followed by insufflation with aristol, was beneficial. It occurred to one of us (J. T. W.) that acetozone inhalant,^b which had proved of value in nonleprous nasal conditions, might be used in leprous rhinitis. Each patient was given an atomizer containing acetozone inhalant (acetozone 1 per cent, chloretone 0.5 per cent in liquid petrolatum) with directions to spray the nasal cavity through the anterior nares three times a day. An oil or vaseline atomizer is essential, as a fine, wide-reaching spray is desired in order to reach the mucous membrane on all sides of the nasal cavity. An inspection of the nose and a microscopic examination of the nasal secretion for lepra bacilli was made in each case before the medication was begun. The bacteriological examination consisted in collecting the nasal secretion, from both sides of the septum, on a sterile cotton swab, smearing it on new clean slides, fixing by heat, and staining for acid-fast bacilli, using Ziehl's carb-fuchsin, steaming one minute, decolorizing for ten seconds in 1 per cent nitric acid in 95 per cent alcohol, and counterstaining with Löffler's methylene blue one minute.

In certain instances a smear was prepared from the material scraped from the septum with a rigid spear-pointed platinum needle. The mucous membrane was lightly scarified, the denuded area being

^a Hollmann, H. T., 1907. Diseases of the Ear, Eye, Nose, and Throat, among Persons Afflicted with Leprosy. *New York Medical Journal*, October 26, 1907.

^b New and nonofficial remedies approved by Council of Pharmacy and Chemistry of the American Medical Association.

scraped with the edge of the needle, the material clinging thereto was smeared on clean, new slides and stained as above.

All the patients receiving the spray had some leprous nasal lesion, the dominant subjective symptom being that of nasal obstruction, while objectively the mucous membrane of the septum showed ulcerations and thickening.

Case No. 1.—Type of disease, tubercular; age, 10 years; sex, male; duration, several years; nationality, Hawaiian. Physical examination: Thickening of the skin over both malar eminences, brows, and ears; tubercles on cheeks, forehead, ears and extremities. Diagnosis of leprosy confirmed bacteriologically.

January 5: Inspection of the nose. No ulcer present; hyperemia with thickening of the mucous membrane on both sides of the septum, with nasal obstruction sufficient to cause interference with sleep. Both sides of the septum bleed freely on swabbing. Microscopic examination: Many acid-fast bacilli, singly and in bundles, having the morphology of the *Bacillus lepræ*, are present in the secretion.

May 20. Receives a nasal spray with directions to use it three times daily.

June 7: Inspection of the nose (18 days). Nasal obstruction much diminished, no ulcer present, mucous membrane on the left side of the septum bleeds readily on swabbing. Microscopic examination of the secretion from the mucous membrane of the septum shows no acid-fast bacilli.

June 14: Inspection of the nose (25 days). Nasal obstruction has disappeared to such an extent that there is no longer any interference with respiration. Microscopic examination of the secretion from the mucous membrane of the septum shows no acid-fast bacilli. Microscopic examination of two smears made from a scraping of the mucous membrane on the right side of the septum shows no acid-fast bacilli.

July 20: Microscopic examination (61 days) of the nasal secretion and of a scraping from the mucous membrane of the nasal septum shows no acid-fast bacilli.

August 6: Inspection of the nose (78 days). No ulcer present, the hyperemia and thickening of the mucous membrane of the nasal septum and the nasal obstruction have disappeared. Microscopic examination of the nasal secretion and of a scraping from the mucous membrane of the septum shows no acid-fast bacilli.

Case No. 2.—Type of the disease, mixed; age, 20 years; sex, male; duration of disease, 4 years; nationality, Hawaiian. Physical examination: Anesthesia of both legs below the knees, and of both forearms in the distribution of the ulnar nerve. Tubercles on both cheeks, forehead, and ears. Infiltration with thickening of the skin over both malar eminences, brows, and ears. Diagnosis of leprosy was confirmed bacteriologically.

January 5: Inspection of the nose. Open ulcers on both sides of the septum, with a thickening of the mucous membrane, especially on the right side, with nasal obstruction. Left side of the septum bleeds readily on swabbing. Microscopic examination: Many acid-fast bacilli, singly and in small bundles, having the morphology of the *lepra bacillus*, are present in the secretion.

March 24: Received a nasal spray with directions to use it three times daily.

June 1: Inspection of the nose (68 days). Open ulcer on right side, but greatly reduced in size. Ulcer on left side has disappeared, but the mucous membrane still bleeds freely on swabbing. Nasal obstruction has disappeared, and the mucous membrane on the left side appears no longer thickened, but a hyperemia still remains. Microscopic examination: Many single acid-fast bacilli were found in the secretion, the small bundles having almost disappeared. The bacilli were morphologically like the *lepra bacillus*.

June 14: Inspection of the nose (82 days). Ulcer present on right side, and is healing around the edges. Left side appears normal. Microscopic examination of the secretion from the mucous membrane shows a few small bundles of acid-fast bacilli. Microscopic examination of the smears made from a scraping of the mucous membrane on the right side of the septum shows many acid-fast bacilli, singly and in bundles, morphologically like the *lepra bacillus*.

August 6: Inspection of the nose (135 days). Ulcer on the right side is no longer visible; however, at the junction of the bony and cartilaginous septum some hemorrhagic crusts are present. Microscopic examination of the nasal secretion shows a few single and one small bundle of acid-fast bacilli, morphologically like the *Bacillus lepræ*. Microscopic examination of the smears made from a scraping of the mucous membrane of the right side of the septum shows many single acid-fast bacilli.

Case No. 3.—Type of the disease, tubercular; age, 41 years; sex, male; duration, 8 months; nationality, part Hawaiian. Physical examination: Infiltration of the skin over the malar eminences and brows; tubercles on ears and left arm. Anesthesia of forearms and entire legs. Diagnosis of leprosy confirmed bacteriologically.

January 5: Inspection of the nose. Deviation of the septum to the right; large open ulcer on the right side; thickening of the mucous membrane on both sides of the septum, with complete nasal obstruction. Mucous membrane on both sides of the septum bleeds readily on swabbing. Microscopic examination of the nasal secretion shows enormous numbers of acid-fast bacilli, singly and in large bundles, morphologically like the *lepra bacillus*.

March 24: Received a nasal spray with directions to use it three times a day.

May 18: Inspection of the nose (55 days). No ulcer is visible; the thickening of the mucous membrane has entirely disappeared, and there is no longer nasal obstruction. Microscopic examination of the nasal secretion shows no acid-fast bacilli. Microscopic examination of smears made from a scraping of the mucous membrane shows no acid-fast bacilli.

June 1: Use of the spray suspended (69 days).

June 14: Inspection of the nose (14 days). No ulcer present and the mucous membrane appears normal. Microscopic examination of the nasal secretion shows no acid-fast bacilli.

Microscopic examination of smears made from a scraping of the septum shows no acid-fast bacilli.

July 8: Inspection of the nose (38 days). Mucous membrane on both sides of the septum appears normal. Microscopic examination of the nasal secretion shows no acid-fast bacilli. Microscopic examination of smears from a scraping shows eight single long, slender, and beaded acid-fast bacilli, morphologically like the *lepra bacillus*.

July 12: Resumed the use of the spray.

August 6: Inspection of the nose (25 days). Mucous membrane on both sides of the septum appears slightly pale and is very dry. No ulcer is visible. There is a small hemorrhagic crust at a level with the anterior part of the middle turbinate bone. Microscopic examination of the nasal secretion from both sides of the septum shows no acid-fast bacilli. Microscopic examination of smears made from a scraping of the mucous membrane from the right side of the septum, beneath the hemorrhagic crust, shows no acid-fast bacilli.

Case No. 8.—Type of the disease, macular-anesthetic; age, 19 years; sex, male; duration, 16 months; nationality, American. Physical examination: A thickening of the skin with macules over both malar eminences, also large macules radiating downward and outward from each side of the spine; anesthesia in the distribution of both ulnar nerves, with contracture of the third and fourth fingers of each hand. Diagnosis of leprosy confirmed bacteriologically.

March 8: Inspection of the nose. Large open ulcer on the right side of the septum; hyperemia and thickening of the mucous membrane with partial nasal obstruction. Both sides of the septum bleed readily on swabbing. Microscopic examination of the nasal secretion shows many bundles and single acid-fast bacilli, having the morphology of the *bacillus lepre*.

April 9: Received a nasal spray with directions to use it three times a day.

June 1: Inspection of the nose (53 days). Ulcer still present but greatly reduced in size. Nasal obstruction has entirely disappeared. General condition of the mucous membrane on both sides of the septum is much improved. Microscopic examination of the nasal secre-

tion shows a few bundles and a moderate number of single acid-fast bacilli, morphologically like the lepra bacillus. Microscopic examination of smears made from a scraping of the mucous membrane at the border of the ulcer shows many bundles and single acid-fast bacilli, morphologically like the lepra bacillus.

June 14: Inspection of the nose (67 days). The mucous membrane at the site of the ulcer presents a smooth, shiny surface, and the general congestion and thickening have entirely disappeared. Microscopic examination of the nasal secretion shows a few single, long, slender, and beaded acid-fast bacilli, morphologically like the bacillus lepræ.

August 6: Inspection of the nose (120 days). The mucous membrane of the right side of the septum is congested and at the anterior part of the middle turbinate bone is a small hemorrhagic crust. No ulcer is visible. Microscopic examination of the nasal secretion at the site of the hemorrhagic crust shows a few bundles and many single acid-fast bacilli, morphologically like the lepra bacillus.

The neuro-trophic lesions involving the patient's hands have prevented a thorough use of the atomizer.

Case No. 9.—Type of the disease, tubercular; age, 12 years; sex, male; duration, not known; nationality, Hawaiian. Physical examination: Infiltration of cheek, nose, chin, brows, and ears; many leucodermic areas on back and buttocks; elephantiasis of both lower extremities, with anesthesia below the knees. Diagnosis of leprosy was confirmed bacteriologically.

January 5: Open ulcers on both sides of the septum, with a congestion and thickening of the mucous membrane and complete nasal obstruction. Microscopic examination of the nasal secretion shows some bundles and many single acid-fast bacilli, morphologically like the bacillus lepræ. Microscopic examination of smear made from a scraping of the mucous membrane shows acid-fast bacilli, singly and in bundles, morphologically like the lepra bacillus.

April 9: Began using the nasal spray three times a day.

May 20: Inspection of the nose (41 days). No ulcer present on either side of the septum. The mucous membrane on the right side of the septum is congested. All signs of the obstruction have disappeared. Microscopic examination of the nasal secretion shows four single acid-fast bacilli, morphologically like the lepra bacillus.

June 8: Inspection of the nose (60 days). The mucous membrane on both sides of the septum is smooth and without secretion. No ulcer or congestion is present. Microscopic examination of the nasal secretion shows no acid-fast bacilli. Microscopic examination of smears made from scraping of the mucous membrane on the septum shows some single acid-fast bacilli, morphologically like the lepra bacillus.

June 8: The use of the spray was discontinued.

June 15: Microscopic examination of the nasal secretion, one week after discontinuing spray, shows no acid-fast bacilli.

July 20 (42 days): Microscopic examination of the nasal secretion shows no acid-fast bacilli. Patient complains of obstruction in upper nasal passage, so spray was again ordered.

August 6: Inspection of the nose (17 days). No ulcer present, no thickening of the mucous membrane, and the obstruction has again disappeared. The mucous membrane is very dry. Microscopic examination of the nasal secretion shows two acid-fast bacilli, very palely stained, not beaded, and rather thicker than the bacillus lepræ. Microscopic examination of smears made from a scraping of the mucous membrane shows a moderate number of acid-fast bacilli, brightly stained and morphologically like the lepra bacillus.

Case No. 11.—Type of the disease, tubercular; age, 69 years; sex, male; duration, unknown; nationality, American. Physical examination: Tubercles on ears and extremities; induration of the skin of the brows and ears; macules on body, buttocks and thighs; anesthesia of forearms and legs, with atrophy of the muscles of the forearms. Diagnosis of leprosy confirmed bacteriologically.

An atomizer, containing acetozone inhalant, was given this patient, to be used for an extensive ulceration of the right side of the septum, thickening of the mucous membrane, and complete nasal obstruction. The ulcer was partially healed, and the nasal obstruction was entirely relieved. The reason that more progress was not made was the patient's inability to use the atomizer properly because of his disabled hands.

Case II.—Type of the disease, mixed; age, 25 years; sex, male; duration, several years; nationality, Hawaiian. Physical examination: Thickening of the skin over cheeks and ears; scars on the face and body from former tubercles; one arm amputated for gangrene. Diagnosis of leprosy was confirmed bacteriologically.

January 5: Inspection of the nose. Ulcers on both sides of the septum, with hemorrhagic crusts; mucous membrane congested and thickened. Complete nasal obstruction was present. Microscopic examination of the nasal secretion shows many acid-fast bacilli, singly and in bundles, morphologically like the lepra bacillus.

March 24: Received a nasal spray with directions to use it three times a day. Inspection of the nose: A large open ulcer on the right side of the septum; hemorrhagic crusts on the left side. Gentle swabbing causes severe epistaxis. Nasal obstruction was distressing. Microscopic examination of the nasal secretion shows enormous numbers of acid-fast bacilli, singly and in bundles, morphologically like the lepra bacillus. Microscopic examination of smears made from a scraping of the nasal mucous membrane shows enormous numbers

of acid-fast bacilli. The field under the microscope appears almost entirely red from the bacilli present.

April 4: Inspection of the nose (11 days). No ulcer present on the left side of the septum. Right side of the septum shows a very small ulcer, with some hemorrhagic crusts still present. Microscopic examination of the nasal secretion shows some acid-fast bacilli, singly and in small bundles, morphologically like the *lepra bacillus*. Many of the bacilli in this specimen take a very uneven and pale stain.

April 21: Microscopic examination of the nasal secretion (28 days) shows a few acid-fast bacilli, morphologically like the *lepra bacillus*.

May 18: Inspection of the nose (55 days). No ulcers visible on either side of the septum, but at the site of the ulcers the mucous membrane appears red, glistening, and dry. The mucous membrane on the left side of the nasal septum appears normal. No hemorrhagic crusts are present, and all signs of the nasal obstruction have disappeared. Microscopic examination of the nasal secretion shows two small bundles and a few single acid-fast bacilli, morphologically like the *lepra bacillus*.

July 20: Inspection of the nose (118 days). No ulcer present on either side of the septum. The mucous membrane appears rather pale and very dry. During the process of swabbing a small hemorrhagic crust was removed, but no bleeding point could be detected. Microscopic examination of the nasal secretion shows eleven single acid-fast bacilli, long and slender, not beaded, and but faintly stained, morphologically like the *lepra bacillus*.

Case L.—Type of the disease, tubercular; age, 9 years; sex, female; duration, unknown; nationality, Hawaiian. Physical examination: Infiltration of the entire face and ears; macules on arms and back; macules and small tubercles on lower extremities; diagnosis of leprosy was confirmed bacteriologically.

January 5: Inspection of the nose. The entire left side of the septum is a large open ulcer, right side shows hemorrhagic crusts, and the mucous membrane is thickened. Nasal obstruction is present. Microscopic examination of the nasal secretion shows enormous numbers of acid-fast bacilli, predominantly in large bundles, morphologically like the *lepra bacillus*. Microscopic examination of smears made from a scraping of the nasal mucous membrane shows very numerous groups of acid-fast bacilli, morphologically like the *lepra bacillus*.

May 7: Inspection of the nose shows practically the same condition as described in the examination of January 5. Patient began treatment with the nasal spray, with directions to use it three times a day.

June 1: Inspection of the nose (25 days). Ulcer almost healed; mucous membrane around the ulcer is hyperemic; mucous membrane on the other side of the septum appears normal; nasal obstruction has entirely disappeared; microscopic examination of the nasal secretion shows some acid-fast bacilli, morphologically like the lepra bacillus.

July 20: Inspection of the nose (74 days). No ulcer visible; some hemorrhagic crusts on the right side on a level with the anterior part of the middle turbinate bone. The mucous membrane appears swollen and pale. Microscopic examination of nasal secretion shows one small bundle and a few single acid-fast bacilli, morphologically like the lepra bacillus. The bundle of bacilli was stained a pale pink and no beading of the component bacilli could be made out.

Case C.—The type of the disease, mixed; age, 22 years; sex, female; duration, several years; nationality, Hawaiian. Physical examination: Thickening and induration of the skin of the cheeks, brows, ears, and chin. Tubercles on forehead, ears, arms, buttocks, and lower extremities. Large macules on the back. Enlargement of both ulnar nerves, with atrophy of the interosseous muscles of the hands and a contracture of all the fingers of both hands. Diagnosis of leprosy was confirmed bacteriologically.

January 5: Inspection of the nose. Large open bleeding ulcer on the left side of the septum. The mucous membrane on both sides of the septum is thickened and there is partial nasal obstruction. Slight trauma of the mucous membrane on the left side of the septum causes severe epistaxis. Microscopic examination of the nasal secretion shows enormous numbers of acid-fast bacilli, singly and in bundles, morphologically like the lepra bacillus.

April 21: Received the nasal spray, with directions to use it three times a day.

June 1: Inspection of the nose (41 days). Ulcer on the left side of the septum greatly reduced in size; mucous membrane no longer thickened, and the nasal obstruction is entirely gone. Mucous membrane on the right side of the septum appears normal. Microscopic examination of the nasal secretion shows a few acid-fast bacilli, singly and in small bundles, morphologically like the lepra bacillus. This specimen shows that the bacilli in the secretion are greatly reduced in numbers, and that many take the stain poorly.

July 20: Inspection of the nose (90 days). No ulcer present; however, there are some hemorrhagic crusts at the site of the former ulcer. The mucous membrane on both sides of the septum is dry and glistening. Microscopic examination of the nasal secretion shows some single, long, and slender acid-fast bacilli (swabbing made from the site of one of the crusts), morphologically like the lepra bacillus. Many of the bacilli take the stain so faintly that no beading could be

made out, and again appeared so short that they seemed to be mere parts of the bacilli.

July 30: For disciplinary reasons this patient was sent to the settlement on the island of Molokai, ending our investigations of the case.

Case E.—Type of disease, tubercular; age, 24 years; sex, male; duration, several years; nationality, Hawaiian. Physical examination: Slight thickening of the skin over the cheeks and brows; ears somewhat enlarged; leucodermic areas on the body on lower extremities. Diagnosis of leprosy was confirmed bacteriologically.

January 5: Inspection of the nose. There were several hemorrhagic crusts on the right side of the septum, which when removed brought to view several small ulcers. The mucous membrane was thickened. There was complete nasal obstruction. Microscopic examination of the nasal secretion from the site of one of the crusts shows a moderate number of acid-fast bacilli, singly and in bundles, morphologically like the *lepra bacillus*.

April 9: Patient received the nasal spray with directions to use it three times a day.

May 18: Inspection of the nose (39 days). No ulcer present; no hemorrhagic crusts; thickening of the mucous membrane greatly reduced, and the nasal obstruction has entirely disappeared. Microscopic examination of the nasal secretion shows a few single, long, slender, beaded acid-fast bacilli, morphologically like the *lepra bacillus*.

June 7: Inspection of the nose (59 days). No ulcer or hemorrhagic crusts present; mucous membrane slightly pale, dry, and glistening. Microscopic examination of the nasal secretion shows no acid-fast bacilli. Microscopic examination of smears made from a scraping of the mucous membrane at the site of one of the former ulcers shows a few single acid-fast bacilli, morphologically like the *lepra bacilli*.

July 30: This patient was sent to the settlement on the island of Molokai, for disciplinary reasons, terminating our investigations.

SUMMARY.

The results of the treatment of ten cases of leprosy rhinitis with acetozone inhalant may be summarized as follows:

1. Nasal obstruction relieved in ten cases.
2. In nine cases presenting ulcerations of the mucous membrane of the nasal septum, eight showed healing of the ulcers.
3. Entire disappearance of the *lepra bacilli* from the nasal secretion was observed in four cases. In two of these cases the bacilli could not even be demonstrated in a scraping of the mucous membrane of the septum. In the six cases remaining the bacilli in the nasal secretion were greatly reduced in number.

DISCUSSION.

In the summary it will be noted that there were six cases in which the bacilli did not entirely disappear from the nasal secretion during the treatment. This may be explained as follows:

Three of these six cases (Nos. 8, 11, and H) could not use the atomizer effectively because of their disabled hands. Case No. 2, who has shown steady progress in the severity of his leprosy, was confined to his bed for some time with a leper fever, during which the spray was not used. This patient also has a tubercular infection, evidenced by a cervical adenitis, necessitating operation.

Case C was sent to the leper settlement before our investigations were completed.

Case L is a young girl, who has given us some trouble by refusing other medications, and it is known that she did not use the spray faithfully.

During the course of our bacteriological examinations of the nasal secretions of our patients, several peculiarities in the staining properties of the lepra bacillus were noted, apparently due to the action of the spray. These changes may be summarized as follows:

The first change noted was that the bundles of bacilli became smaller and they were fewer in number until, in several cases, they disappeared altogether, the bacilli being only found singly. The next change was in the staining properties of the individual bacilli, many of them taking the stain poorly and the beading seeming to be absent. In our last series of examinations of the nasal secretions a marked change was noticed in the bundles, as follows:

Occasional areas were found in the preparations of the size and shape of a bundle of lepra bacilli, composed of a homogeneous substance staining a faint pink, with acid-fast granules scattered throughout. These granules took a bright red stain, appearing like "beads" or the darker staining sections of the lepra bacilli. No individual bacilli could be made out in these areas, and the picture suggested a bundle of disintegrating bacilli with fusion of the component units.

The mechanism of communication of leprosy is unknown, but inasmuch as in tuberculosis we know that the disease may be transferred to a healthy person by "spray infection," and we know that in leprosy with nasal lesions a similar bacillary spray exists, we feel justified in reasoning by analogy and concluding that if the nasal secretion of a leper can be freed from the specific bacilli, the result will be prophylactically very important.

It is a routine measure with us to give each one of our patients, having a nasal lesion, an atomizer containing acetozone inhalant. This not only heals the ulcerations and to a greater or lesser extent rids the nasal secretion of the bacilli, but also makes the patient more comfortable by relieving the nasal obstruction.

CONCLUSIONS.

1. A systematic use of a spray composed of acetozone and chlore-tone in liquid petrolatum in cases of leprous rhinitis relieves the distressing nasal obstruction characteristic of the disease; brings about healing of the ulcerations so frequently present on the nasal septum, and greatly reduces the number or causes the entire disappearance of the lepra bacilli in the nasal secretion.

2. We believe that if this treatment is thoroughly carried out the lepra bacilli will eventually be entirely eliminated from the nasal secretion, a factor, which to our minds is so important in the communicability of the disease that it hardly requires emphasis.

3. From the point of view of the patient, a treatment which by relieving the nasal obstruction permits uninterrupted sleep, and by healing the ulceration of the nasal mucous membrane, frees him from epistaxis, is of considerable moment.



